Part 1. Report Cover

Original Report Number: 00AYP021 **Original Report Date(s):** 22 Sep 00

Title: Performance Oriented Packaging Testing of a PPP-B-601, Style A, Cleated-Plywood Box With Skids, 36? inches by 24 inches by 12 inches (ID), Containing Packaged Solids (361 lb Gross)

Responsible Individual: Francis S. Flynn

Performing Activity: LOGSA Packaging, Storage, and Containerization Center
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Performing Activity's Reference(s): 9HTRR; TE 35-97; AMC 13-88

Report Type: Interim Final

DTIC Distribution: N/A

Requesting Organization:
Defense Logistics Agency
Defense Distribution Center
ATTN DDC TO
2001 Mission Drive
New Cumberland PA 17070-5000

Requesting Organization's Reference(s):
DLA Memo, 14 Oct 99

RN: 00AYP021

Test Results: ___ single _X_ combination ___ composite

Section I. Pre-test Conditions

For initial testing, one box was received in new condition, from the post box fabrication shop.

The following identification schema designates the packaging specimen used for the test(s) indicated.

Specimen No.	Test
A	stack test
A	repetitive-shock vibration test
A	flat onto bottom, drop test
	flat onto top, drop test
	flat onto long side, drop test
	flat onto short side, drop test
	bottom corner, drop test

Section II. Summary

A. Drop test - *1.8 m (PG II solids)* **PASS**

flat onto the top (face 1)	PASS
flat onto the bottom (face 3)	PASS
flat onto long side (face 4)	PASS
flat onto short side (face 6)	PASS
bottom corner (5-2-3)	PASS

B. Leakproofness test -
restrained under water/soap over seams N/A

production testing, 20 kPa, 5 min.	N/A
design qualification, 20 kPa, 5 min.	N/A
salvage drum requirement, 20 kPa, 5 min.	N/A

C. Internal pressure test/Hydrostatic pressure test (liq.) - N/A

D. Stacking test - *static load, 2,000 lb, 24 hr* **PASS**

E. Vibration standard - *repetitive-shock, rotary motion*
4.33 *Hz., 1 hr* **PASS**

F. Water resistance test (fiberboard box) - N/A

G. Compatibility test (liq. in plastics) - N/A

Test Results (continued)

Section III. Discussion

A. Drop test: *49 CFR §178.603*

___ cold conditioned (0° F, 72 hr)
_X_ ambient conditions
___ standard conditions (50% RH & 23° C)

No.	Ht.	Orientation	Results
A[1]	1.8 m	Flat onto box top (1)	Pass/No leaks/rupture; entire contents retained
A[1]	1.8 m	Flat onto box bottom (3)	Pass/No leaks/rupture; entire contents retained
A[1]	1.8 m	Flat onto box long side (4)	Pass/No leaks/rupture; entire contents retained
A[1]	1.8 m	Flat onto box short side (6)	Pass/No leaks/rupture; entire contents retained
A[1]	1.8 m	Diagonally onto bottom joint corner (5-2-3)	Pass/No leaks/rupture; minor crushing of the 5-2-3 corner; contents retained completely within the box

For each orientation for the drop test, a free fall drop plate, 10 x 10, set for 1.8 meters (71 in.), was used. The impact surface was a steel plate.

In conducting the drop test, all five drops (flat top, flat bottom, flat long side, flat short side, and bottom corner) were performed on the same configuration. The decision to use the same container (configuration) for all five drop orientations was based on the relatively minimal damage demonstrated during previous testing of plywood boxes with different inner containers or articles. Five drops per configuration exceeds *49 CFR §178.603* requirements, as well as both UN and ASTM recommendations (i.e., one drop on a side or corner per box). The use of one configuration for multiple tests and drops is DOD policy as stated in DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/MCO 4030.40A, Packaging of Hazardous Material. Also per this policy, any failed orientation(s) can be repeated using another configuration.

B. Leakproofness test: *49 CFR §178.604*

N/A. The leakproofness test was not conducted on the box, because the packaging is not intended for the containment of liquids.

C. Internal Pressure/Hydrostatic Pressure test: *49 CFR §178.605*
N/A. Testing for the maintenance of internal pressure is not required for configurations of solids.

Test Results: Section III (continued)

D. Stacking test: *See 49 CFR §178.606.*
___ standard conditions (23° C & 50% RH)
_X_ ambient conditions (~72° F)
___ high temperature conditions (104° F)

No.	Length	Type	Load/Force	Peak Force	Results	Stability Maintained?
A[1]	24 hr	Static	2,000 lb	N/A lbf	Pass	Yes

A static top load (2,000 lbs) was used for the stack test, because it could hold the load constant for the required 24-hour timeframe. The total top load to be applied was greater than the minimum required for one box based on the outside box height and the gross packaged weight. The top load was to simulate a stack of identical packagings that might be stacked on the packaging during transport.

E. Vibration test: *See 49 CFR §178.608.*

No.	Frequency	Duration	Results
A[1]	4.33 Hz	1 hr	Pass. No leakage, rupture, or damage

To be in compliance with U.S. Department of Transportation standards for packagings bearing the United States mark (USA) as a component of the packaging certification marking (*49 CFR §173.24a(a)(5)*), the vibration test was performed, as a means to determine capability. The test was conducted as prescribed by ASTM D 999, method A2 (Repetitive Shock Test (Rotary Motion)). The test was run for 1 hour, using the plywood box packaging. The packaging was tested using a 2,000-lb vibration table (rotary motion) that had a 1-inch-vertical double amplitude (peak-to-peak displacement) such that the packaging was raised from the platform to such a degree that a piece of steel strapping (1.6 mm) could be passed between the bottom of the package and the platform.

F. Water resistance (Cobb Method) test (fiberboard): N/A

G. Compatibility test (plastics packagings only): N/A.

Note 1. Specimen A, a packaging consisting of a plywood box lined with singlewall fiberboard, containing solids.

Test Personnel

The personnel who performed the aforementioned testing, or had a role in the testing, evaluation, and/or documentation, as reported herein are recorded in the test files.

References

A. Title 49 Code of Federal Regulations, Parts 106-180, Spring 2000, current as of 14 Jan 00

B. International Air Transport Association Dangerous Goods Regulations, 40th edition, 1 January 1999

C. ASTM D 4919, Specification for Testing of Hazardous Materials Packagings.

D. ASTM D 999, Standard Method for Vibration Testing of Shipping Containers.

E. ASTM D 951, Standard Test Method Water Resistance of Shipping Containers by Spray Method.

F. TAPPI Standard: T 441 Water Absorptiveness of Sized (Non-Bibulous) Paper and Paperboard (Cobb Test).

G. Recommendations on the Transport of Dangerous Goods, sixth revised edition, United Nations, New York, 1990.

H. DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/ MCO 4030.40A, Packaging of Hazardous Material, 23 Jul 96

I. AFJMAN 24-204/TM 38-250/NAVSUP PUB 505/MCO P4030.19G/DLAI4145.3, Preparing Hazardous Materials for Military Air Shipments, 1 Mar 97

Equipment

Item	Manufacturer	Serial No.	Calibration Expiration Date
2,000-lb vibration table	L.A.B Skaneateles, NY	G23605	*see note*
30,000-lb compression tester	Gaynes Engr. Co. Franklin Park, IL	G20950	4/01
release hook	Gaynes Engr. Co. Franklin Park, IL	18211-1	N/R

Note. Equipment is calibrated in accordance with International Safe Transit Association test equipment verification requirements.

Appendix A

Test Applicability

Pass/fail conclusions were based on the particular box specimens, test loads, and the limited quantities submitted for test. Extrapolation to other materials, other manufacturers, other applications, different inner packagings, container sizes, or lesser inner quantities is the responsibility of the packaging design agency or applicable higher headquarters. Extrapolation of test results based on less than the minimum recommended number of test specimens is also the responsibility of the packaging design agency or applicable higher headquarters.

Reference to specification materials has been made based either on the information provided by the requester, the manufacturer, or the markings printed on, attached to, or embossed on the packagings. It was not possible to identify the exact composition of the box construction materials.

Testing was performed per *Title 49* Code of Federal Regulations.

Performance testing was undertaken and completed at the request of an agency responsible for shipment of the dangerous good(s). The completion of successful required performance tests does not, by itself, authorize the marking and transportation of the dangerous good(s). Applicable modal regulations should be consulted concerning the relationship of performance testing completed and the dangerous good(s).

The required performance tests are intended to evaluate the performance of the packaging components. The criteria used to evaluate packaging performance is whether the contents of the packaging are retained within the outer packaging, should damage to the outer packaging occur, and secondly, if any inner packaging of hazardous materials leaks, ruptures, or is damaged so as to affect transportation safety. The successful completion of the required tests does not ensure the undamaged delivery or survivability of the actual commodity/item. Separate testing is necessary to assure the stability of any explosive item.

Before a configuration can be certified by the person(s) authorizing shipment, the appropriate packaging for the particular hazardous materials and mode of transportation must be determined, and the item(s) must be prepared for shipment per applicable regulations. The chosen configuration must have been performance tested in accordance with the size, the shape, and the weight constraints posed by the configuration to be certified. The testing reported herein

should not be construed as blanket certification of any configuration which simply uses the performance tested outer box. Packaging paragraphs apply.

Appendix B

Test Data Sheet

Section I. Test Product

Physical State: _X_ solid ___ liquid ___ gas ___ aerosol

Test Product(s) Used: 28 BA-358U batteries, 9" x 6?" x 4¾", 280 lbs (10 lbs ea); 8 BA-358U batteries, 7¼" x 2?" x 2?", 20 lbs (2.5 lbs ea); and 1 lb of fiberboard. Total weight is 301 lbs.

Amount Per Container:

Item Weight-- 318 lbs.
Tare Weight-- 63 lbs.
Gross Weight-- 381 lbs.

Section II. Test Parameters

Drop Height: Ref: *49 CFR §178.603*

_X_ **1.8 m;** 71 in. (PG I, II, & III, SG =1.2 or **solids**)
___ 1.2 m; 47 in. (PG II & III, SG =1.2 or solids)
___ 0.8 m; 32 in. (PG III, SG =1.2 or solids)
___ ___ m; __ in. (other, PG ___, SG ___)
from-- ___ PG I: SG x 1.5 m, SG x 59.06 in.
___ PG II: SG x 1.0 m, SG x 39.37 in.
___ PG III: SG x 0.67 m, SG x 26.38 in.

Stacking Weight Formula Solids

Variables		Inputs	Calculations	
h	height, drum/box	38.25	38.25	
n	# stacked containers	XXXXXX	3.08	
w	gross packaging weight	361		
A	Stacking weight	XXXXXX	**752.67**	**753**

NOTE: A=(n-1)*w
A=applied load in pounds
n=(118/h), minimum number of containers that when stacked, reach a height of 3m
w=maximum weight of one packed container in pounds

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Appendix C

Packaging Data Sheet

Section I. Exterior Shipping Container

Packaging Category: ___ single _X_ combination ___ composite

UN Type: Plywood boxes (*49 CFR §178.514*) UN Code: 4D

Specification No.: PPP-B-601; Style A; Cleated plywood box with skids; 60 lbs.; 36?" x 24" x 12" (ID); 38¼" x 26-1/16" x 17¾" (OD)

Manufacturer: Department of Defense, Defense Distribution Depot Tobyhanna, Tobyhanna, PA 18466

Date(s) of Manufacture: plywood box not marked

Closure Method: The outer plywood box was sealed using 8 penny cement coated sinkers. The box was then banded with flat steel strapping; 3 girthwise, 2 horizontal. (See drawing)

Static Electricity Protection: N/A

Appendix C (Continued)

Section II. Interior Cushioning

Quantity of Inner Containers: N/A Capacity: N/A

Cushioning: The plywood box was lined with singlewall fiberboard. (see drawing)

Cushioning Specification/Date: ASTM D4727, V3c, WR; 11/96

Closure Type(s): See exterior container closure method.

Appendix D

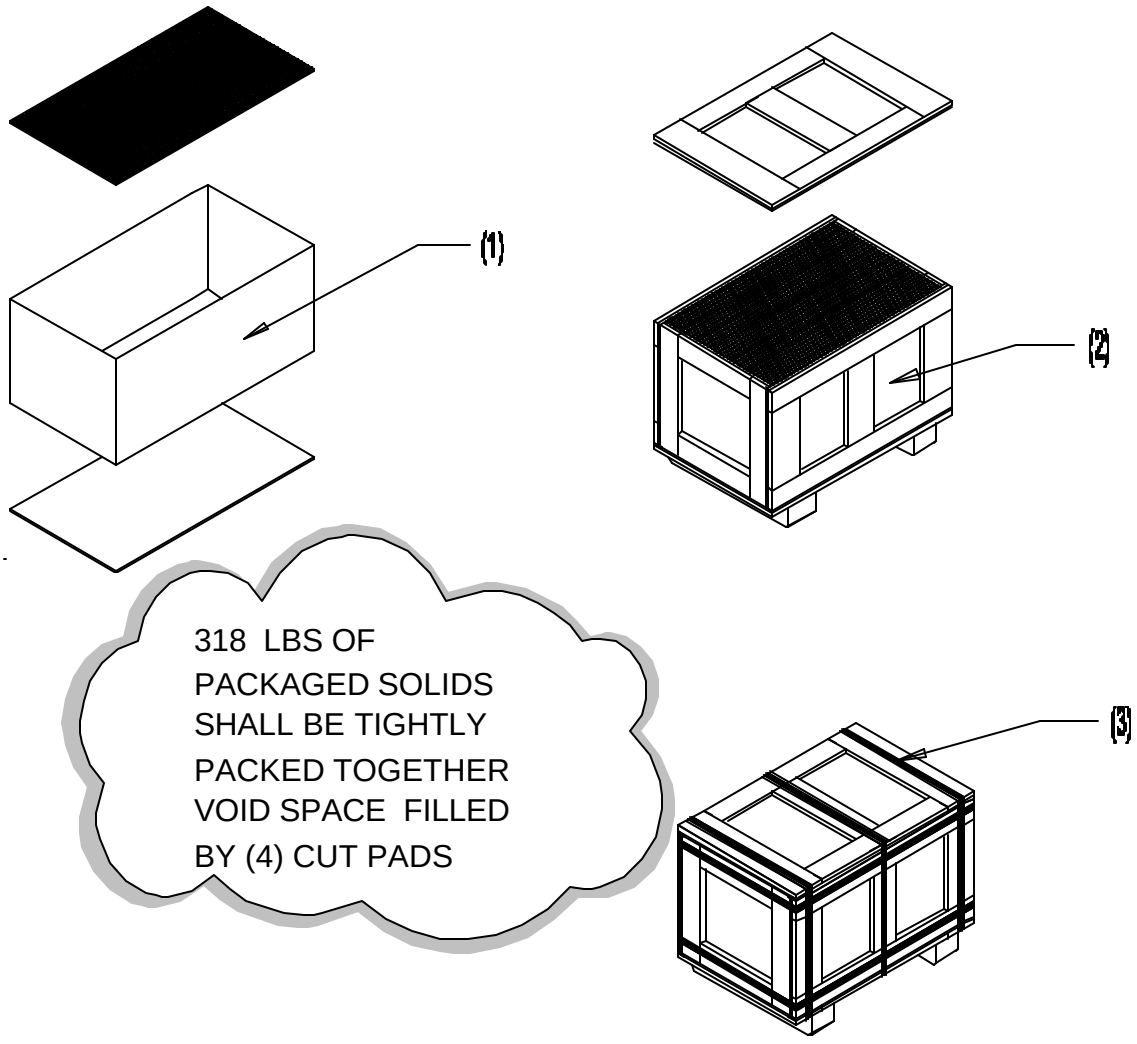
Rationale

There may be other articles having dimensions close enough to the dimensions of the tested configuration to invoke the use of variation 4 for selective testing of combination packagings. This variation to testing requirements, found in *49 CFR §178.601(g)(4),* authorizes each external dimension (length, width, and height) to be less than or equal to the corresponding dimension of the tested design type. This allows lessening of the dimensions to provide a snug fit around the packaging as described in the SPI for the associated items. The tested weight has to be greater than or equal to the intended weight for any item. Per *49 CFR §178.601(g)(6),* the provisions of variation 4 may be applied to articles rather than just inner packagings.

One packaging, made to the above described configuration (several differing articles in a cushioned plywood box), was subjected to drop and vibration testing as prescribed in ASTM D 4919. These tests are designed to simulate the shock and vibration a package configuration) may encounter when being shipped worldwide by truck, rail, or ocean going transport. The order of testing was vibration, then drop testing. Prior to the rough handling testing of the packed box, static loading was performed on the packed box.

Appendix D (Continued) RN: 00AYP021

Drawing



ITEM	DESCRIPTION 00AYP021
1	FIBERBOARD, GRADE V3c IAW ASTM D 4727, 2 FIBERBOARD PADS 36 IN. BY 24 IN., (TOP & BOTTOM), 1 SLEEVE 35-5/8 IN. (LONG) BY 23-5/8 IN. (WIDE) BY 11-5/8 (HIGH)
2	PPP-B-601, STYLE A, CLEATED-PLYWOOD BOX WITH TWO SKIDS AND INTERMEDIATE CLEATS 36 x 24 x 12 IN. (ID)
3	¾ x .023 IN. STEEL STRAPPING, FLAT, TYPE 1 REGULAR DUTY, FINISH A, IAW ASTM D 3953, 3 GIRTHWISE, 2 HORIZONTAL BANDS
4	FIBERBOARD OR POLYETHYLENE PADS, CUT TO FIT VOIDS